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ABSTRACT

The relationship between placement of adjunct questions in instructional material and incidental and intentional learning was investigated. A total of 150 undergraduate students assigned to five experimental groups studied ten paragraphs with questions interspersed at different locations in the text. Performance on incidental items was significantly lower in the question before (QB) than in the question after (QA), question before and after (QBA), and the no-question (NoQ) groups. Performance on intentional items by the QB subjects was significantly lower than the QA and the QBA subjects. The results also suggest that the QB and the QA effects of questions combined additively to produce the performance of the QBA subjects. A surprising finding indicates that although performances differed between the QB, QBA, and QA conditions in the immediate recall task, post reading performance of the QA and QBA subjects became equal and above the QB subjects. This may mean that depth-of-processing is the relevant operation to focus upon. Educational implications are discussed. (Author/RD)

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Additive Effects of Pre- and Post-Adjunct Questions In Prose Text

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Abstract

A total of 150 undergraduate students randomly assigned to five experimental groups studied ten paragraphs with questions interspersed at different locations in the text. Performance on incidental items was significantly lower ($p < .05$) in the question before (QB) than in the question after (QA), question before and after (QBA), and the no-question (NoQ) groups. Performance on intentional items by the QB subjects was significantly lower ($p < .05$) than the QA and the QBA subjects. The results also suggest that (a) the QB and the QA effects of questions combine additively to produce the performance of the QBA subjects, and (b) the attention operation is equivalent across conditions for intentional items, but differs in retention operation. This may mean that depth-of-processing is the relevant operation to focus upon.

Additive Effects of Pre- and Post-Adjunct Questions in Prose Text

Background

Under certain conditions the incorporation of questions in instructional material (i.e., adjunct questions) facilitate the amount learned from text due to their mathemagenic properties (Frase, 1967; 1968a, 1968b, 1968c; Rothkopf, 1965, 1966; Rothkopf & Bisbicos, 1967; Rickards & Di Vesta, 1974). The typical experimental paradigm involves placing questions within (interspersed) and immediately before (prequestioning), or immediately after (postquestioning) a passage. The control (or comparison passage) contains the text material without questions. Following the reading of the passage a posttest is administered to the learner. The test is comprised of questions about the material encountered within the passage (Intentional items) and "new" questions about the material (Incidental items). The repeated questions measure the amount of intentional learning that takes place in the sense that the information elicited parallels that deemed important in typical classroom situations. The "new" items are sampled from what is psychologically a domain of knowledge other than that represented by the repeated questions. Knowing the answer to the relevant questions does not necessarily imply knowing the answers to the "new" items. The "new" items test the acquisition of knowledge which is considered by the author of the text material to be peripheral to the instructional objectives defined by the intentional items. Hence, they are considered as measures of incidental learning.

By varying relations between questioned and nonquestioned material, learning behavior and consequent outcomes can be controlled, or shaped. Thus, postquestions can modify mathemagenic behaviors, by extinguishing

inspection behaviors which fail to result in learning the requisite skills for fulfilling the task demands, and behaviors which result in successful performance are strengthened.

Under postquestion conditions the learner cannot anticipate the question(s) to be asked. Accordingly, the entire passage must be read carefully. If careful reading has resulted in successfully answering the postquestion, then the probability of reading the next passage in a similar manner will be increased. If it has resulted in failure to answer the question, other modifications will be made in an effort to eliminate inappropriate reading behaviors. Postquestioning becomes progressively adaptive with progressive increases in success on intentional items and progressively decreases in success on incidental items.

Prequestioning has not been found to facilitate performance to the extent that postquestioning has. Positive effects on intentional items, but not on incidental items have been reported by a number of investigators (Rothkopf, 1966; Frase, 1967, 1968c; Frase, Patrick & Schumer, 1970; Anderson & Biddle, 1975; Rickards, 1976). Presumably, they serve as cues to identify relevant content, but in the process, inhibit responses to incidental questions. The depressed scores on incidental items may be due to the rejection of information not related to answering the questions (Frase, 1968a).

The absence of experimental questions has quite a different message for the learner. It implies that all information within the passage is equally important, and the adoption of generally successful methods of dealing with such material is essential. Since the learner's subjective interpretation of the learning task influences his/her objectives, all material within the

no-question context is considered incidental (to the author's intended objectives) for purposes of investigation.

From the framework of the cybernetic model of behavior (Frase, 1969) an adjunct question can be used by the learner to determine whether or not achieved behavior (what the student places in memory) coincides with the criterion of acceptable behaviors (the correct answer). Thus, a learner confronted with a question will proceed to read the paragraph to find the answer. Failure to do so generates an error signal (negative feedback). The error signal has the effect of requiring the learner to alter the strategy applied to subsequent paragraphs in order to find positive feedback in the form of meeting some (externally or internally imposed) criterion. Adjunct questions, therefore, are more than nominal stimuli. They become effective stimuli, directing the students' attention to those responses necessary to correctly answer the question. Furthermore they increase the probability that the learner responds discriminately in unique ways and depending on the implied objectives, to the passage.

Attention and Retention Operations

A further theoretical framework hypothesizes the existence of two operations (Boyd, 1973): (a) attention, that is, the process of putting information into some form of storage which becomes operational in immediate or nearly immediate recall of information; and (b) retention, that is the ability to retrieve the material from storage. Within this view, the pre-question cues the learner to attend more to intentional material than to incidental material, but the forgetting rate for both types of material will be the same once the material has been stored. Accordingly, prequestions

influence selective attention but not selective forgetting. Postquestions influence attention and retention of incidental material about the same as the no-question treatment, but enhances retention and retrieval of intentional material. On the basis of such evidence Boyd speculated that the combination of pre- and postquestions should be additive in its effects. Thus,

> . . . if prequestions increase a subject's attention for intentional material and postquestions retard the rate of forgetting for material attended to, then the effect of giving a set of prequestions with identical postquestions should be to increase intentional posttest scores more than a set of pre- or postquestions alone . . .. (p. 32)

Support for this view was obtained through the failure to find an interaction between type-of-learning and average performance on an eleven-treatment-matrix.

The present study was designed to further investigate the validity of the additive model proposed by Boyd concerning the combined effects of pre- and postquestions. The hypothesis was that the combination of pre- and post-questions would result in performance on a posttest which was equivalent to that of performance under prequestion alone, plus that of performance under post-question alone. In order to test this hypothesis adequately, several methodological provisions, some of which have been neglected in previous studies, were provided. These provisions were as follows:

1. In order to enhance the generalizability of results to a general college population, a heterogeneous sample of college students from a variety of sources, were employed. Sampling in the past was often made from a homogeneous target population (for example, college sophomores in introductory psychology, office workers, and paid volunteers). Furthermore, the tasks

in the present study were administered under naturalistic study conditions.

2. Defined procedures were employed, regarding development of an item pool corresponding to a "domain" of knowledge and the placement of adjunct questions within the text.

3. The items for the adjunct questions and for the criterion tests were selected at random such that there were thirty different forms of the test employed and randomly administered to subjects.

4. In order to provide for comparison of results with other studies, provision was made for replication groups in the design.

The presentation is made with the hope that some of these issues may attract further research on this topic for eventual better understanding of the processes involved.

Method

Design

The 2 x 5 experimental design implied the use of a mixed analysis of variance with two factors: a between-subjects factor consisting of five levels of question-placement (all combinations of questions before and questions after, plus two control groups, i.e., "test-only" and no-questions) and a within-subjects factor consisting of two levels of type-of-learning (intentional and incidental).

Subjects

The subjects (n = 150) were volunteers from among the undergraduates matriculated at a land grant eastern university. Some (n = 13) came from an introductory educational psychology course for which course credit could be earned by participating in the project. The remaining subjects (n = 137)

were students living in the university residence halls and were not enrolled in the introductory educational psychology course. Each subject was randomly assigned, by reference to a table of random digits, in one of the five experimental treatments, with the restriction of recycling randomization at N + 1 treatments. There were thirty subjects in each treatment.

Stimulus Material

A meaningful passage of approximately 800 words on vitamins was divided into ten paragraphs, each of which was comprised of seven sentences. Each sentence contained one main idea. Open-ended questions which could be correctly answered with one-to-three words, were constructed for each of the seventy sentences.

Item Selection Procedure

Each main sentence idea was incorporated into a question representing one of several topics such as names, measures, technical terms or dates. The resulting seventy questions comprised the population or "domain" of all items represented in the passage. Each paragraph contributed seven questions to the item pool and corresponds to a paragraph subpool of questions or a "subdomain" of items.

Through the use of computer text processing programs, forty questions were randomly selected from the domain of items for the adjunct questions and for the postreading criterion measure. A set of forty items contained equal representation (n = 4) from the ten subdomains. The randomization procedure specified the random number generator to duplicate questions across treatments. The order of the questions in the criterion measure was further randomized to reduce the likelihood that any one item could be answered

merely because it duplicated the sequence of material within the passage or other similar artifactual effect. Each subject within any condition received a unique set of questions but the same set of questions appeared in each condition, and represented a replication of items across treatments. Thus, there was a total of thirty different forms of the test and adjunct questions.

Procedure

Students were permitted to sign up for an experimental session convenient to their schedules. An average of seven subjects participated during any one session. Subjects reported to a central area, where general instructions were delivered by the experimenter. Upon answering questions if any existed, the experimenter handed out the prerandomized booklets to the subjects in a clockwise order. The "test-only" subjects were requested to remain behind for further instructions. Subjects were required to find a room where they could feel comfortable studying alone and to return once they finished so that the criterion test could be administered. The need to follow instructions was highly stressed. The stimulus material was designed to be self-administered once the subjects received the booklets and recorded their time. The test-only subjects were given further explanation as to their role (to obtain a knowledge base on the target population on the topic of vitamins so that performance could be compared to the remaining conditions). To ensure that subjects processed each adjunct question, he had to write the question (in paraphrase form) as well as answer it as each was encountered.

As each subject finished studying the test, the finishing time was recorded and the booklet material was returned and exchanged for the corresponding criterion measure. When both parts of the task were completed,

the experimenter inquired if (a) their role on the task was understood, (b) directions were followed and (c) progression through the stimulus material was in a forward direction only. If a "no" answer was suspected, the subject's data were discarded. A random check of twenty-five subjects was made to ensure that directions were being followed. The data of four subjects were dropped because the subjects were suspected of violating one of the above conditions.

At the completion of the tasks a brief explanation of previous findings was delivered and an informative discussion usually followed, giving the experimenter deeper insight as to the processes involved.

Results

The initial question in need of answering was: Does randomly selecting questions from a "domain" of items produced equivalent tests? The ANOVA procedures were applied to the thirty different postreading criterion measures for intentional, incidental and total performance scores on five identical tests. All statistical tests indicated that the hypothesis of equivalent criterion measure could not be rejected, (all p's were greater than 0.58). The implications are that since the hypothesis of equivalent criterion measures cannot be rejected, likewise the belief that the item selection procedure produces equivalent tests cannot be rejected. The finding can now be interpreted as being caused by the treatment to which each subject was exposed.

The "test-only" subjects' scores proved to be significantly lower ($p < 0.01$) than the remaining scores. This suggests that the materials were appropriate for the target population and that any change from this

base knowledge can be attributed to the treatment to which subjects were exposed, (refer to Table 1).

Total Intentional and Total Incidental Effects of Questions

The data were analyzed using a 2 x 4 analysis of variance with two levels of type-of-learning (intentional and incidental) and four levels of question-placement. Since subjects in the no-question condition did not encounter any intentional items, a value equal to the incidental items was inserted for the purpose of analysis (refer to Figure 1).

The analysis resulted in a significant interaction between type-of-learning and placement-of-questions level, $F(3,116) = 19.96$, $p < 0.001$, therefore, the Newman-Keuls follow-up procedure was used to test simple effects. Performance was significantly better ($p < 0.01$) for intentional effects of QA and QBA subjects than the average performance on the remaining treatment groups. Subjects in the prequestion group produced significantly lower incidental learning ($p < 0.001$) performance than all other subjects ($\bar{X}_{QB} = 40.66$). There was no significant difference between the NoQ subjects (for both intentional and incidental) performance ($\bar{X}_{NoQ} = 64.08$) and the QB subjects' intentional performance ($\bar{X}_{QB} = 67.83$). As can be verified by the data depicted in Figure 1, performance on intentional items was significantly higher ($p < 0.001$) than incidental items for all subjects (except for the NoQ treatment group, of course).

The fact that the NoQ subjects' intentional scores were replaced with their incidental scores caused the interaction to be significant in the above analysis. The QB, QA and QBA intentional scores were analyzed separately via a 2 x 3 ANOVA, to determine if, in fact, an interaction between factors

existed. The interaction was nonsignificant at the 0.01 alpha level. As a further test of the additivity model of performance, the intentional performance was individually analyzed using the hypothesized model in Equation 1.

$$NoQ + |(QB - NoQ)| + |(QA - NoQ)| = QBA \qquad (1)$$

$$64.08 + |(69.7 - 64.08)| + |(79.0 - 64.08)| = 83.92$$

The underlying assumption in the above analyses is that since each subject was randomly placed in a treatment group, the score was equally likely to occur in combination with any other subject, therefore the above equation could be applied. The actual mean score, when calculated for each replication, for the QBA subjects was 77.83, which does not depart significantly ($p < 0.05$) from the hypothesized value of 83.92. As an added check on the above additive performance model, a test was carried out of the interaction component. As would be expected, the test for an interaction was found to be nonsignificant, [$t(116) = -0.85$, $p < 0.001$], using the error term from the total intentional percentage scores analysis ($MS_E = 388.10$). The implication is that the effect of the QBA treatment approximates the effects of the additive combination of QB and QA according to the additive performance model depicted in Equation 1.

The attention and retention operations, as discussed by Boyd (1973) were investigated within this study. Each subject's task included writing the adjunct question immediately upon its encounter as well as writing the answer. This procedure was used to assure that questions were processed. All subjects were found to have followed these instructions. The data were analyzed using a 3 x 2 analysis of variance procedure, with three levels of the between-subjects factor (QB, QA, and QBA) and two levels of recall

performance (immediate recall and postreading test recall). The results are represented in Figure 2, and provide visual evidence that there occurs an interaction between factors (is also confirmed by the significant interaction $F(2,87) = 4.08$, $p < 0.02$). Since the question must be answered immediately after reading the relevant passage and supposedly no other event has taken place requiring the subjects' attention between presentation of stimuli and immediate recall, performance within the stimulus material provides an indication of the "attention" operation. How well the learner has attended to the material is directly reflected by this immediate recall. Performance on immediate recall is nonsignificant between the three conditions, however, the QA average performance is somewhat lower.

Performance on postreading criterion measure is significantly lower [$F(1,87) = 118.97$, $p < 0.001$] than immediate recall of the same items. The QB performance is now significantly lower than both the QA and QBA conditions. Unfortunately we cannot extrapolate over time (beyond the postreading performance). This analysis signifies that attention is equal among the three conditions. What is not clear, however, is if processing among the conditions (depth of processing) is equal. Performance in the postreading criterion measure indicates that retention is poor (compared to QA and QBA). A surprising finding seems to be that although performances differ between the QB, QBA versus QA conditions in the immediate recall, performance on the postreading test by the QA and QBA subjects become equal and above the QB condition.

A general conclusion one is led to make is that the depth of processing for the QA and QBA is greater than the QB conditions. What we are unable to ascertain is if depth of processing differs between QA and QBA and between

immediate and postreading testing. The fact that performance actually interacts does not tell us whether it is due to the attentive operation or the forgetting operation.

Adaptive Nature of Postquestioning

To test for the existence of trends in performance across the ten consecutive paragraphs, the data for each subject was divided into a performance score for the first five paragraphs and a performance score for the last five paragraphs. The fluctuation in performance in any condition may be due to (a) differences in difficulty level of the questions, (b) location of the question-relevant information within the passage, (c) the learners' attempts to "tune in" on the "correct" inspection activities required for the task, (d) possible interference between the subjects' inspections habits and the inspection activities demanded of the learner by the experimental task, or (e) a combination of some or all of the above. The analysis carried out were 2 x 2 analysis of variances with two within-subjects factors, (performance on paragraphs 1-5 versus performance on paragraphs 6-10, and incidental versus intentional performance). The performance of subjects in each condition was analyzed separately. The postquestioning subjects were the only group to produce diverging performance (as can be verified in Figure 3) thereby indicating an interaction between the two factors, [$F(1,29) = 10.01$, $p < 0.004$]. The conclusion which can be derived from such trends is that the QA condition is causing learners to perform at a higher level in the latter half of material than on the first half for intentional questions and the reverse is true for the incidental questions.

Discussion

This study clearly demonstrated differences in learning outcomes produced by variations in the location of adjunct questions embedded in textual materials. The results were in substantial agreement with the stated hypotheses, as well as with previous investigators. The heterogeneous sample of subjects provides for a greater generalizability of results than most related studies which have used a more restricted sample of the general population.

Educators are constantly faced with the problem of what questions to ask so as to tap the learners' cognitive structure appropriately to evaluate stated objectives. A system of rules for generating a pool of every possible test item of interest in a field of knowledge has been developed (Hively, Patterson & Page, 1968; Hively, 1970). In selecting items to evaluate the learner, one would randomly sample from the pool, with the constraint that the test be made up of so many items from each unit (i.e., paragraph, page or chapter). Given the domain were properly constructed, such a procedure would reduce biasing to a chance level, and decrease the probability that only one type of question would be asked (i.e., name, measure, common phrase, date) or that the question-relevant information be found at the same location within each unit of material. The item selection procedure was successfully demonstrated in the present study to encourage its future use. The procedure has the advantage of each subject being equally likely of receiving any item and the ability to develop a unique test (yet equivalent test) for each subject.

No-Questions (NoQ)

Given that the subjects in the NoQ condition understand they are to expect a post-reading criterion test, attentive and retention behaviors are

believed to remain constant across paragraphs. Individuals have no way of knowing either before or after studying a paragraph, what the appropriate attentive behaviors are or what is important to attend to. The NoQ group would attend to all information equally, incorporating previously learned study skills and inspection behaviors taking into account stated, implied or perceived task-appropriate instructions. The present investigations supports the conclusion that performance on incidental items is expected to be higher than subjects in other treatment groups because no interference is produced by having to deal with questions embedded in the text.

Prequestions (QB)

Prequestioning, evidently limits the range of attentive behaviors to question-relevant information only. The individual skims the material for the answer, and once the information necessary to answer the question has been located, the individual recognizes it to be the answer to the question and concentrates on transferring the information into storage for later retrieval. Because information prior to the question has only been skimmed, thorough understanding of the peripheral (to central idea) material has not taken place, and the question-relevant information must now be "pieced together" from only partially attended material. The learner is unable to associate all question-related ideas to correctly answer the questions. This closely relates to the notion that the individual, upon encountering the information necessary to answer the prequestion, recognizes it to be the answer without further processing of related information and thus is reflected in the deflated incidental scores. This might appropriately be labelled the "Oh yes, here's the answer" phenomena. If storage is attempted, the information is stored in memory at the arbitrary level (i.e., rote,

associative or episodic). Breakdown may occur either in the inability to store either part of or all of the information. If the individual is able to store the information, difficulty may arise in remembering the appropriate cues necessary to retrieve it, (ineffective storage and retrieval). After the target information has been located within the paragraph, the remaining portion of the paragraph may be skimmed much like earlier material or may be skipped altogether, with the thought that having answered the prequestion the task is complete. A characteristic of this search process results in a depressed incidental item performance due to lack of attentive behaviors directed to incidental information. Intentional item performance will not be as high as would be expected, due to the lack of a complete and meaningful experience (theme) attached to the information at the time of storage. In short, organization of material and processing of the information is hindered, (or at least not aided). Other investigators (Frase, 1968c; Frase, et al., 1970) have suggested that prequestions serve as cues to identify relevant information and will cause an inhibition of responses to incidental stimuli, thus decreasing incidental learning. The evidence provided by this study leads to the conclusion that in the prequestion condition, inhibition of responses is also present in intentional learning, and is most likely due to the above reasoning.

Postquestioning (QA)

In the postquestioning condition the individual is unaware as to what shall be the demands, therefore, one proceeds to carefully attend equally to all information as in the NoQ condition. When the question is encountered at the end of the passage, a systematic search of the stored information takes place for the information necessary to answer the question. This

forces the attentive behaviors to be equal to the NoQ condition, but the postquestion allows the individual an added "practice trial". The added practice trial increases the probability that the same information is retrieved on the postreading criterion measure provided, of course, it was corectly retrieved immediately after the paragraph. The forgetting rate decreases (that is, less is forgotten) because of this practice trial for intentional information, but for the incidental information the rate of forgetting remains the same as in the NoQ control group. The result is better organization of information causing a more efficient retrieval process at time of posttest recall. According to Rothkopf and Bisbicos (1967) postquestions can modify mathemagenic behaviors by extinguishing and dropping ineffective behaviors and strengthening successful performance. In concert with Rothkopf and Bisbicos, the data suggest that the mathemagenic behaviors, at least for the QA condition are adaptive: performance for intentional items progressively increases as performance on incidental items progressively decreases.

Pre- and Postquestions (QBA) - The Additive Performance Model

One can speculate that if prequestions increase attentive behavior and postquestions increase retention of information due to the "practice trial" which forces greater processing and aids organization of information, then the net result is that the QB and QA processes additively combine to result in the QBA performance. The individuals are hypothesized to attend to all information at the level equal to the QB condition because the subjects encounter the prequestion first and thus the "target" (correct) information is searched for. However, realizing that a postquestion must also be dealt with, attentive behaviors equal to those of the QA subjects take over. In both

cases, the fact that the questions must be answered again the practice trial increases the retention of the question-relevant information through better organization and increased processing. The strictly QB or QA attentive and retention behaviors do not adequately describe the QBA performance and must be modified. Modification of attentive behaviors most likely affects how the learners process the information on intentional learning.

It is believed that the performance of the NoQ subjects plus the incremental percentage scores of QB and QA, additively combine to produce the QBA intentional performance. The QBA organization of material implies the learner's ability to take advantage of the beneficial processes present in both prequestioning and postquestioning conditions. The beneficial processing by the QBA most likely would show up when recall would be measured in the more realistic situation of recall during delayed testing situation (a more realistic aim of education). That is, to test for the retention of information over an extended period of time. Thus better performance over time, due to the more thorough processing of the material would lead us to conclude that pre- and postquestioning condition leads to "processing advantage" not found in other conditions, singly.

Educational Implications

The evidence produced by the present experiment leads to recommending the procedure of constructing an item pool on a domain of knowledge and randomly selecting questions to construct individualized tests. Text processing computer programs similar to those used in this experiment, may be used to facilitate such a procedure. The use of a "test-only" control group is absolutely essential in any learning experimental design that deals with

connected discourse, so as to ascertain the base knowledge of the target population on the stimulus material, at the time of the experiment. The claim that one procedure is "better" than a second or that it even produces any effects which it may claim, must be verified by comparing it to the control group representing the natural state of the population. The lack of efficiency measures and the absence of proper control groups have been two areas which have been criticized for not having been adequately attended to in the past (Faw & Waller, 1976).

Adjunct prequestions are detrimental to performance on incidental items and are only slightly helpful on intentional learning. Past indications have been that frequent adjunct questioning interfere with incidental learning (Frase, et al., 1970), yet the NoQ control group's performance was found to be only slightly better (but not statistically significant) than all other question groups on incidental learning.

The performance by subjects, relative to serial position of paragraphs, appears to be erratic and extremely variable for most of the conditions. However, performance fluctuates about the overall mean score of the ten paragraphs and thus performance may roughly be described by the overall mean. The fact that performance is at the same level for paragraph number one as in paragraph ten refutes the claim that appropriate inspection activities are learned. The evidence suggests that the activities already exists within the individual and the learner merely mobilizes them into action. The post-questioning condition is the exception to the above generalization, demonstrating that the QA findings are in agreement with the adaptive inspection behaviors as discussed by Frase and Rothkopf and their associates. Although performance

(by the QA subjects) seems equivalent at the beginning, there is a strong divergent trend, with intentional item performance increasing and incidental item performance decreasing with each successible paragraph. Logical questions to ask with respect to postquestioning inspection behaviors are:

1. How is this divergent trend affected by the number of units of material?

2. How is efficiency related to each unit of material?

3. What exactly are the causes of this interaction effect?

The importance of the additive performance model results are that it implies placing questions both prior to and after the question related passage, but more importantly helps to investigate the attention and retention operations claimed to be involved in adjunct question research. The fact that the QA and QBA conditions result in equivalent intentional performances, and the learner is exposed to twice as many questions also means that twice as many questions get answered correctly. The "attentive" operation is the same for all three conditions (although the depressed QA condition scores must be pointed out). The "retention" operation produces equivalent performance for QA and QBA, but a significantly lower QB condition performance. The significance of this finding suggests that the "attention" operation is not the important operation, but rather the "depth of processing" is, which QA and QBA conditions encourages the learner to undertake. The depth of processing directly influences the retention of material over time.

As a closing comment, we are led to make the following statement in relation to adjunct question research. Since the results of this investigation, as well as other previous research (see Anderson & Biddle, 1975; Faw & Waller, 1976) not produce overwhelming evidence to the contrary,

it appears entirely reasonable to conclude that the instructional outcomes of questions have not fully been revealed, and must be if the intent is to use questions only when they produce education, efficient, and desirable outcomes.

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TABLE 1

Average Performance[1] For Each Set of Questions

QUESTIONS	Treatment				
	Test-only	NoQ	QB	QA	QBA
Total Incidental Questions	16.6	64.08	40.6	58.6	60.2
Total Intentional Questions	16.6*	64.08+	69.7	79.0	77.8
Total Questions	16.6*	64.08	47.9	63.8	69.0

[1]Performance is measured in percent of correct responses.

*Subjects in the "test only" condition were not exposed to the stimulus material, but were given the criterion test. Items only in the final test, by definition, measure incidental effects, but are assumed to measure intentional effects as well in the control group.

+All items in the NoQ treatment group measure incidental effects by definition, however, the intentional score is assumed to be equal to that of incidental items.

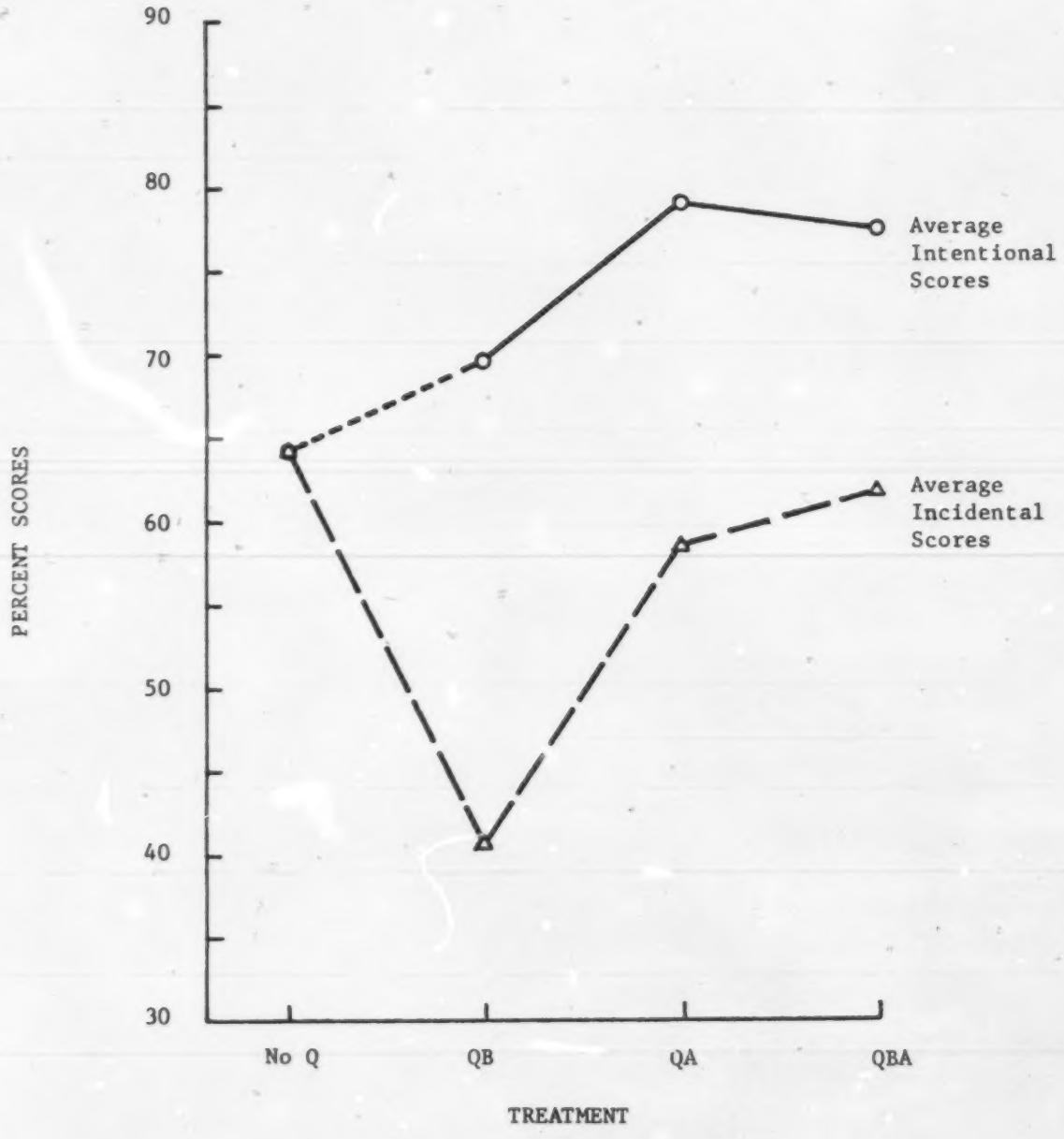

Figure 1: Total Intentional and Total Incidental Performance Across Treatment Groups

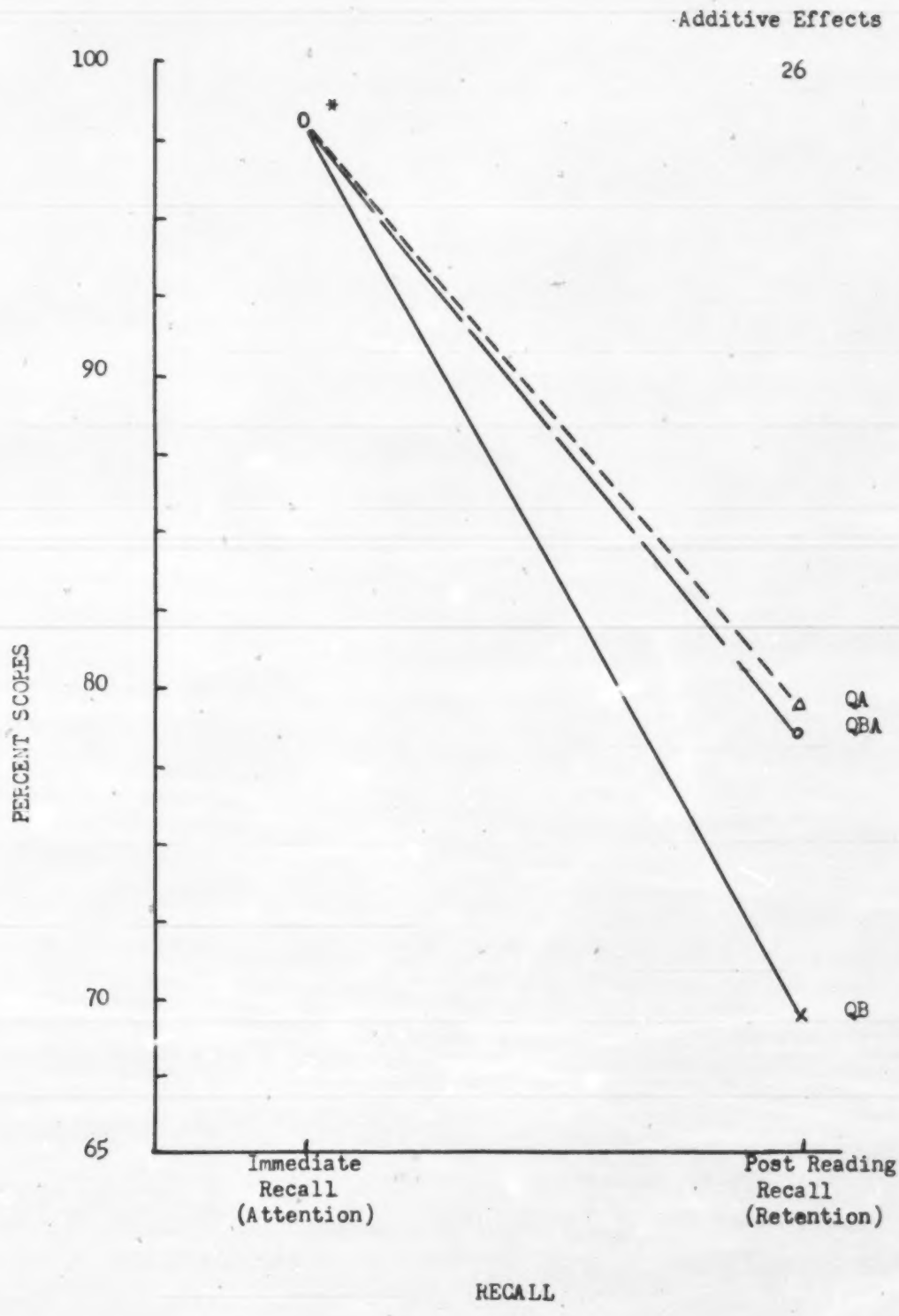

Figure 2: Performance indicators, "attention" and "retention" operations.

* Failure to find diffential affects on immediate recall allows us to simplify our data by using the "pooled" mean. This more clearly depict the non-differential effects of attention and the diffential effects of retention.

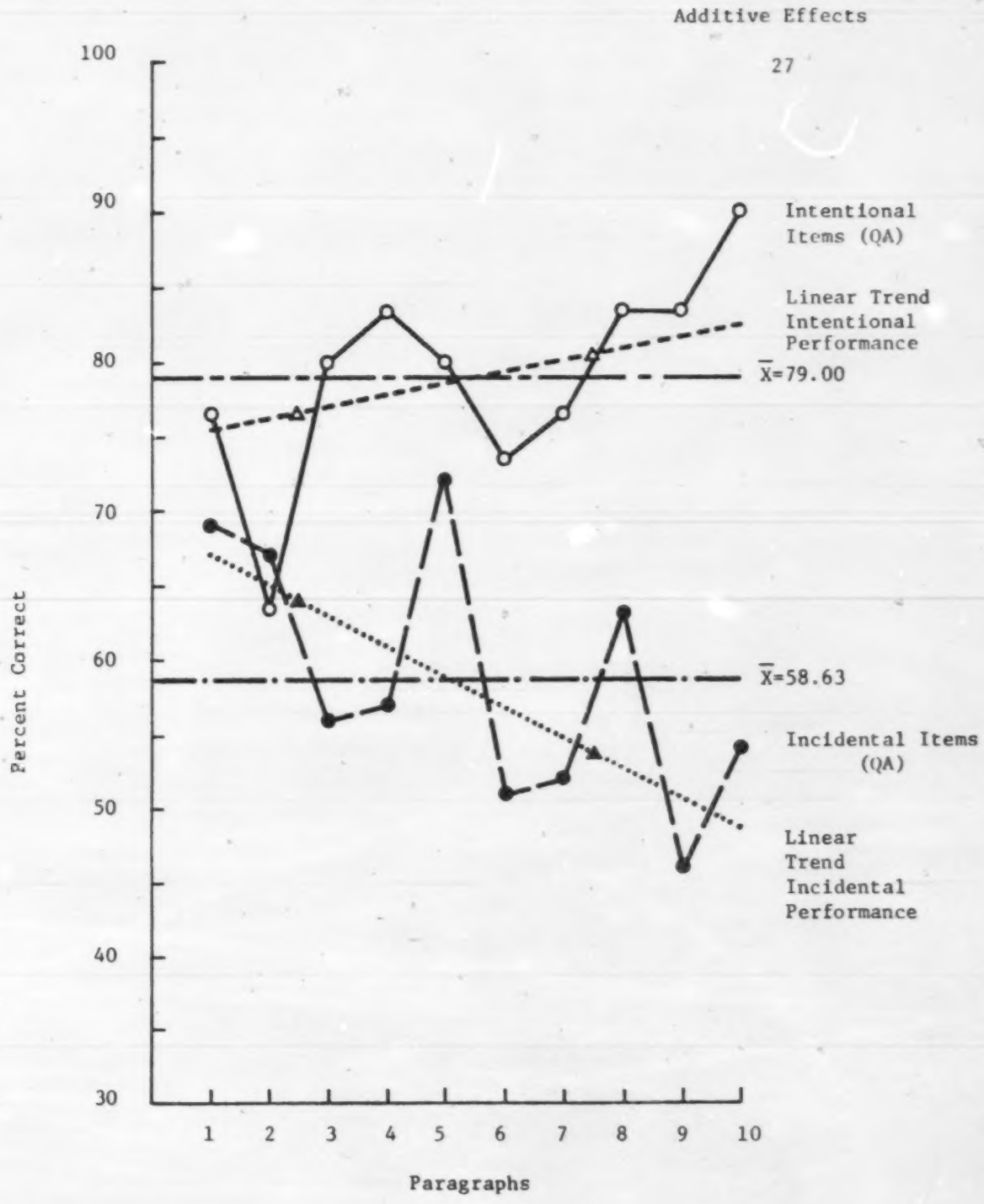

Figure 3: Performance Across Paragraphs Postquestions